3.3.2 Flooding

Floods are the result of a multitude of naturally-occurring and human-induced factors, but they all can be defined as the accumulation of too much water in too little time in a specific area. Types of floods that affect Montana include regional floods, flash floods, ice-jam floods, and dam-failure floods.

Flood plains are lands bordering rivers and streams that normally are dry but are covered with water during floods.

3.3.2.1 Background

- Factors that directly affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth and water-resistance of the surface due to urbanization.
- During the 20th century, floods were the number-one natural disaster in the United States in terms of the number of lives lost and property damage.
- Buildings or other structures placed in flood plains can be damaged by floods.
- Buildings and fill material can change the pattern of water flow and increase flooding and flood damage on adjacent property by blocking the flow of water and increasing the width, depth, or velocity of flood waters.
- Most homeowner insurance policies do not cover floodwater damage. Individuals and business owners can protect themselves from financial losses by purchasing flood insurance through FEMA's National Flood Insurance Program.

  Sources: FEMA 2003; USGS 2000; NOAA 2004a.

3.3.2.1.1 Regional and Flash Floods

Riverine floods result from precipitation over large areas and/or from snowmelt. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include many independent river basins. The duration of riverine floods may vary from a few hours to many days.

Flash floods are local floods of great volume and short duration. In contrast to riverine flooding, this type of flood usually results from a torrential rain on a relatively small drainage area. The flood wave from flash floods can move downstream too fast to allow escape, resulting in many deaths. Most flood-related deaths are due to flash floods. Fifty percent of all flash-flood fatalities are vehicle related. Two feet of water is all that is necessary to carry most cars downstream during a flood.

Flash floods can occur within several seconds to several hours, with little warning. They can be deadly because they produce rapid rises in water levels and have devastating flow velocities.

Factors contributing to flash flooding include: rainfall intensity, rainfall duration, surface conditions, and topography and slope of the receiving basin. Urban areas are susceptible to flash floods because a high percentage of the surface area is composed of impervious streets, roofs, and parking lots where runoff occurs very rapidly. Mountainous areas also are susceptible to flash floods, as steep topography may funnel runoff into a narrow canyon. Source: USGS, 2000; NOAA, 2004a.

Of specific concern for many Montana areas are flash floods as a result of rain falling in wildfire burn areas. This type of flash flood can occur rapidly with less amounts of rainfall than is normally needed for flash flooding. Areas downslope of recently-burned areas are at an increased risk for flash flooding and the associated mudslides.

3.3.2.1.2 Ice Jam Floods

An ***ice jam*** is an accumulation of ice in a river that restricts water flow and may cause backwater that floods low-lying areas upstream from the jam. Downstream areas also can be flooded if the jam releases suddenly, sending a flash flood downstream.

Damages resulting from ice jams can affect roads, bridges, buildings, and homes, and can cost the affected community thousands to millions of dollars. In most instances, ice jams result in highly localized, yet serious damages, which makes it difficult to obtain the type of disaster assistance available for large-scale flooding events.

3.3.2.1.3 Dam Failure Floods

Dam failure floods have usually been associated with intense rainfall or prolonged flood conditions, but could occur during an earthquake. Dam failure may be caused by faulty design, construction and operational inadequacies, or a flood event larger than the design flood.

The greatest threat from dam failure is to people and property in areas immediately below the dam since flood discharges decrease as the flood wave moves downstream.

The degree and extent of damage depend on the size of the dam and the circumstances of failure. A small dam retaining water in a stock pond may break resulting in little more damage than the loss of the structure itself. In contrast, a dam break could result in the loss of irrigation water for a season, causing extreme financial hardship to many farmers. An even larger dam failure might bring about considerable loss of property, destruction of cropland, roads and utilities and even loss of life. Consequences of dam failure that are more far-reaching can include loss of income, disruption of services and environmental devastation (MDES, 1996).

3.3.2.2 History of Flooding in Montana

Flooding is a common occurrence in Montana. Spring run-off from winter snow annually threatens downstream communities. The following discussion summarizes historical flooding in each major Montana watershed.

3.3.2.2.1 Columbia River Basin Flooding

The Columbia River Basin has been subject to numerous significant flooding events over the years. Some of these events are described below:

- The June 1908 flood in Missoula County involved nearly every major stream and river. This event was the result of unseasonably warm temperatures and thirty-three (33) consecutive days of rain.
- In June 1964, approximately fifteen (15) inches of rain accumulated over a (30) thirty-hour period in the upper Flathead drainage. The resulting flood damaged more than 350 houses near Kalispell. The Army Corps of Engineers estimated that the damages in the Flathead Basin totaled **$25 million**.
- In January 1974, the counties of Lincoln, Sanders, Flathead, Glacier, Mineral, Missoula and Deer Lodge were hit by flood waters which caused approximately **$16 million** worth of damage to Forest Service roads, bridges, and facilities, and private property. These same counties suffered flood related losses again in June 1975, totaling nearly **$35 million**.

Source: MDES, 1996.

3.3.2.2.2 Missouri River Basin Flooding

The most damaging flood in the Missouri River Basin occurred in June 1964. The principal rivers involved were the Dearborn, Sun, Teton and Marias. The event was initiated by eight to ten inches of rain over three days on a deeper-than-average snow pack. All counties situated along the Continental Divide were affected to some degree. However, the greatest damage was received by the City of Great Falls. This disaster resulted in the loss of 30 lives and an estimated **$55 million** in damages, with the greatest damage in the city of Great Falls. The Army Corps of Engineers completed a **$12 million dollar** flood control levee along the north bank of the Sun River near Great Falls, which protects over 500 homes and businesses.

In 1984, the combination of snowmelt and spring rains with frequent ice jams caused flooding on the Beaverhead River near Dillon. Crews successfully prevented major damage by channeling floodwaters through town on streets lined with sandbags and straw. The Clark Canyon Dam above Dillon and emergency dikes built on the river near town reduced potential damages.

Significant floods have occurred on the Milk River and its tributaries primarily as a result of rapid snowmelt over frozen soil. Heavy rains caused the greatest flood on record for this river in April 1952; damages between Havre and the river's mouth below Nashua were in the **millions of dollars**. Levees offered limited protection to the communities of Havre, Chinook, Malta, Saco, Glasgow, and Nashua.

Source: MDES, 1996.

3.3.2.2.3 Yellowstone River System Flooding

The Yellowstone River system is one of the remaining large rivers in this country that does not have a major flood control dam, with the exception of the Yellowtail Dam on the Big Horn River. Large floods have affected the Glendive area near the end of the Yellowstone River, typically as a result of ice jams. Flooding in 1899 took four lives and destroyed a new bridge. The Army Corps of Engineers built a levee in 1959, which protects a portion of the town. Miles City, located at the junction of the Tongue and Yellowstone Rivers is one of the more flood prone towns in the state. Limited protection of the city is afforded by levees. Most recently, extensive flooding occurred in Park County near Livingston in 1996 and 1997. Source: MDES, 1996.

3.3.2.2.4 Flash Floods

Flash flooding is common in some areas of the state during the summer storm season. The best examples of this type of flooding have occurred in the Billings area. Flooding of the tributaries of the Yellowstone River has resulted from intense summer thunderstorms, typically short in duration, which produce high peak flows. Major flooding of this type occurred in 1923 and 1937. Flash flooding is also common along drainages in Lincoln, Sanders, Flathead, Glacier, Mineral, Missoula and Deer Lodge Counties during the summer storm season. Source: MDES, 1996.

3.3.2.2.5 Ice Jam Flooding in Montana

There have been 1,419 ice jam events recorded in Montana, the most of any state in the U.S**.** The areas with the most recorded ice jam events are Miles City on the Yellowstone River (33) and Bozeman on Hyalite and Bridger Creeks (32). The towns of Nashua, Sidney, Zortman, Wolf Point, and Harlowton each have more than 20 recorded events (**Figure 3.3.2-1**). The most ice jams reported for one river have occurred on the Missouri River, with 109 events (10%), followed by the Yellowstone with 95 (8.5%), and the Milk River with 81 (7.8%) events.

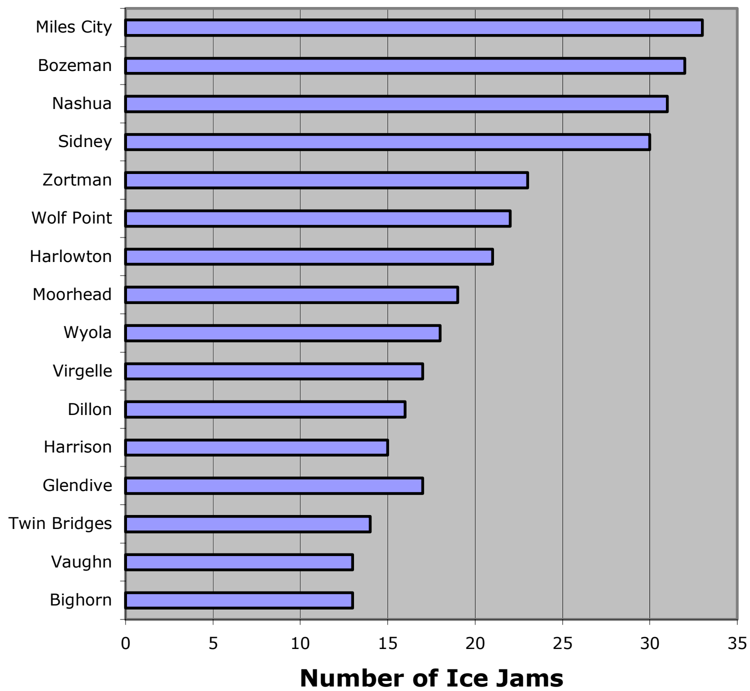

Figure 3.3.2-1 Montana cities with the most reported ice jams.
Source: USACE CRREL, 1998

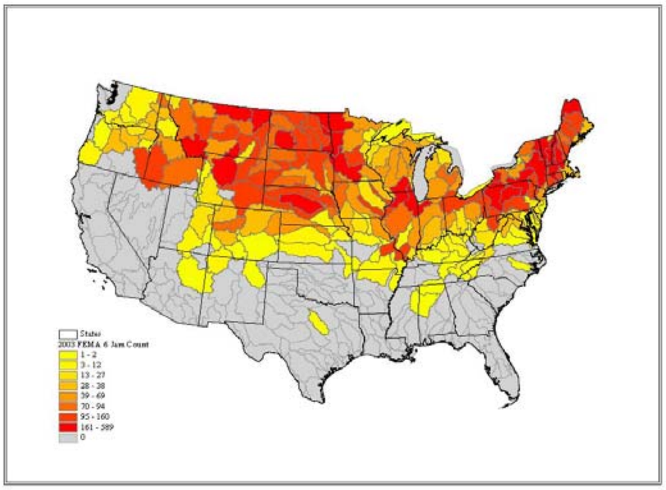

Figure 3.3.2-2Number of Ice Jams in U.S. shown by Hydrologic Unit.
Source: USACE CRREL, 2004.

Approximately 11% of the reported ice jams in Montana have known damages. The most common damages include bridge and residential damage, road flooding, evacuations, dike and levee damage, and agricultural damage.

There have been at least 14 deaths from ice jam flooding in Montana. The majority of these deaths were due to flash floods released during ice jam break-up. Sources: USACE CRREL, 1998 and 2003.

Table 3.3.2-1 Who is Affected by Ice Jams in Montana?

For Montana residents living near rivers, ice jams can cause loss of life, damage to property, roads and structures, and disruption of lives. Examples of some of the damages caused by ice jams are listed below.

Loss of Life:

- 1894: Three men died while trying to escape ice jam flood waters in the Glendive area.
- 1899: Eight people lost their lives to an ice-jam and flash flood in the Glendive area on the Yellowstone River.
- 1996: A volunteer in Fort Benton collapsed and died from a heart attack as he was helping to load sandbags.
- 1996: Two died because of ice jam flooding.

Property Damage:

- 1881: Main Street in Miles City filled with water from an ice jam in March. Residents evacuated to higher ground for one week, which they spent in tents, waiting for the floodwaters to recede.
- 1944: An ice jam on the Tongue and Yellowstone Rivers in Miles City caused 300 to 500 people to be evacuated from their homes.

Agricultural damage:

- 1972: Yellowstone River ice jam in Richland County inundated 2500 acres of farmland, resulting in loss of fertilizer and damage to fill ditches.
- 1994: Rosebud County ice jam caused flash flood that killed 60 cattle, a loss of $60,000.

Environmental Damage:

- 1996: Fish killed in the Blackfoot River by habitat destruction and disruption of spawning activity.
- 1996: Fish killed in Clark Fork River by ice jam scouring and releases of soils contaminated with metals toxic to fish.

Source: USACE CRREL, 1998

3.3.2.2.6 Dam Failure Floods in Montana

Dam failure floods in Montana have primarily been associated with riverine and flash flooding. Nevertheless, the potential for a major flood occurring solely as a result of dam failure is a real possibility. Dam-failure related flooding in Montana is summarized in **Table 3.3.2-2.** As shown in the table, there have been 34 deaths and extensive property damage from dam-failure flooding in Montana.

Table 3.3.2-2 Montana Dam Safety Disasters.
Source: MDES, 1998, 2003; Maxim, 2003a, 2003b**.**

Date	Event	Damages
1927	**Pattengail Creek Dam in Beaverhead County** failed causing four known deaths and near complete destruction of the towns of Dewey and Wise River.	4 deaths
March 1939	**Midway Dam**, 40 miles northwest of Nashua, breached during the Porcupine Creek flood when the spillway was undermined by huge floating ice cakes. When the dam failed, a four-foot liquid wall swept down the valley causing extensive damage.	
July 1946	**Carrol Dam**, located eight miles northwest of **Plentywood**, failed following several inches of rain in a short timeframe. There were no fatalities attributable to the dam failure but destruction was evident throughout the 15 mile valley which took the brunt of the flood. Several homes and farm buildings were destroyed.	
April 1952	**Frenchman Dam** on Frenchman Creek failed upstream of the Milk River. The dam was located in Phillips County, 20 miles north of Saco. The dam failure caused the highest peak ever recorded on the Milk River below its confluence with Frenchman Creek.	$150,000
1964	Failure of **Swift Reservoir on Birch Creek and Two Medicine Dam on Two Medicine Creek** resulted in the loss of thirty (30) lives in the Missouri River Basin.	30 deaths
June 20, 1984	**Browns Lake Dam**, located in **Beaverhead County**, was overtopped resulting in washed out roads and bridges downstream.	Property damage: $100,000
July 11, 1996	Incident Response in **Granite County** (EO 16-96) for the possible failure of the **East Fork of Rock Creek Dam.**	
June 1, 1998	Incident Response for **Tin Cup Dam** (EO 9-98). State response to leak in Tin Cup Dam, located in the **Selway-Bitterroot Wilderness Area** of the Bitterroot National Forest, Ravalli County.	
Spring 1998	**Anita Dam** outlet failure – BLM dam – north of Chinook. Evacuation necessary.	
Summer 2002	Failure of **Ross Dam** in Garfield County; evacuation necessary but limited damage downstream.	

3.3.2.3 Declared Disasters from Flooding Events

Montana counties with emergency and disaster declarations for floods since 1974 are shown in **Table 3.3.2-3.** There has been $24 million in Federal and nearly $5 million in State assistance for damages to public structures and infrastructure in the past 30 years, or about $1 million per year. Damages by types of floods from 1993 to 2003 are listed in **Table 3.3.2-4.** From 1993 to 2003 there was about $18.2 million in disaster assistance within Montana, or about $1.8 million per year.

The NOAA (2004b) data in **Table 3.3.2-4** does not reflect the 3 deaths in 1996 from ice jam flooding documented by the USACE (1998) (**Table 3.3.2-1**).

Table 3.3.2-3 State and Federal Declarations for Flooding in Montana (1974 to April 1, 2004). Source: MDES, 2004.

Date	State and Federal Declarations (code)	Public Assistance			Individual Assist		Total
		State Dollars	Federal Dollars	Local Dollars	Federal	State	
1974	FDAA-417-DR-MT		$603,144				$603,144
1975	FDAA-472-DR-MT and IFG-267 Grants		$2,070,551		$385,023	$128, 341	$2,455,574
1976	Town of Froid	$31,268		$718			$31,986
1978	FDAA-558-DR-MT and IFG-226 Grants	$140,876	$3,838,126	$25,874	$465,015	$155,005	$4,624,896
1979	Fergus & Petroleum Counties	$97,048		$885			$97,933
1981	FEMA-640-DR-MT; FG-486 Grants	$944,132	$4,733,120	$313,286			$5,990,538
1984	Beaverhead and Madison County	$607,600		$51,559			$659,159
1986	FEMA-761; 777-DR-MT; IFG-106 Grants	$212,442	$2,390,854	$584,501	$127,209	$42,403	$3,357,409
1991	EO 12-91; 14-91; EO 15-91; EO 24-91	$570,459		$94,849			$665,308
1993	EO 11-93	$105,630		$15,910			$121,540
1994	EO 04-94; 05-94	$64,156		$4,339			$68,495
1995	EO 1-95; EO 15-95	$38,994		$385			$39,379
1996	EO 12-96	$196,876		$128,484			$325,360
1996	EO 3-96; FEMA 1105-DR-MT	$241,888	$1,820,739	$365,006			$2,427,633
1996	EO 7-96; FEMA 1113-DR-MT	$179,892	$1,480,471	$313,594			$1,973,957
1997	EO 4-97; 5-97; 6-97; 7-97; 12-97; FEMA-1183-DR-MT	$583,222	$5,762,964	$1,413,362			$7,759,548
1997	Ice Jams (EO 2-97)	$1,988					$1,988
1999	EO 3-99	$546,305		$10,062			$556,367
2001	EO 19-01	$56,322		$15,424			$71,746
2002	Spring Snow Storm (EO 13-02) FEMA 1424-DR-MT	$35,783	$1,405,259	$432,636			$1,873,678
2003	EO 4-03; 5-03	$14,963		$92,898			$107,861
TOTAL		**$4,669,843**	**$24,105,228**	**$3,863,773**	**$977,247**	**$197,408**	**$33,813,499**

Table 3.3.2-4 NOAA Montana Flood Summary for 5/6/93 to 8/23/03.
Source: NOAA, 2004b.

Location or County	Death	Injuries	Property Damage	Crop Damage	Total
Ice Jams	0	0	$2,134,000	$0	$2,134,000
Flash Floods	0	0	$4,509,000	$1,245,000	$5,754,000
Regional Floods	3	0	$9,778,000	$500,000	$10,278,000
Urban/Small Streams	1	0	$75,000	$0	$75,000
TOTAL	**4**	**0**	**$16,496,000**	**$1,745,000**	**$18,241,000**

3.3.2.4 Vulnerability to Flooding in Montana

Flooding becomes a hazard when people compete with nature for the use of floodplains. If floodplain areas were left in their natural state, flooding would not cause major damage. Urban, industrial and other surface development in natural floodplain areas of Montana has increased the vulnerability to serious flooding. The extent of artificial surface area created by development prevents rainfall from soaking into the ground and increases the rate of runoff.

3.3.2.4.1 Statewide Vulnerability to Flooding

Riverine and Flash Flooding

Vulnerability to flooding is dependent on local weather conditions, local development patterns and site specific flood water constraints. Some areas can be completely immune to flooding because the steep incised river banks have physically impeded development near the river, limiting flood damage when floodwaters arrive. Other areas experience flooding annually where meandering rivers have created broad floodplains and development has encroached and impeded floodwaters. Because local conditions have a significant impact on the vulnerability to flooding, historic data on occurrence and loss is the best means to assess flooding vulnerability statewide.

The historic flooding damage indirectly identifies the vulnerability to flooding. The National Flood Insurance Program (NFIP) is the primary insurer for flood insurance in the U.S. The NFIP paid over **$5 million** in claims from the flooding of insured properties from 1978 through 2003 in Montana (NFIP, 2004). The 5 counties and 5 cities with the highest flood insurance claims are shown below in **Table 3.3.2-5.** Note that although flood insurance claims are being used to show past losses, this data is not an entirely accurate representation of flood losses. Many homeowners without flood insurance may have sustained flood damages and those losses would not be reflected in these figures.

Table 3.3.2-5 Communities With Highest Flood Insurance Claims (Dollars).
Source: NFIP, 2004.

Counties	
Park	659,964.98
Valley	420,559.22
Sweet Grass	378,110.27
Missoula	317,202.49
Yellowstone	297,150.29
Cities	
Miles City	256,435.36
Roundup	212,754.84
Billings	190,055.60
Columbia Falls	110,829.13
Bozeman	110,466.04

Figure 3.3.2-3 shows the number of recorded flood events and the aggregate value of flood insurance claims by county.

Ice Jam Flooding
Ice jam flooding is more likely to occur in break-up events as opposed to freeze-up events. Sudden seasonal changes are likely the greatest factor increasing the risk of ice-jam flooding. Prolonged cold periods causing significant ice formation followed by unseasonably warm periods in the winter or spring are likely formulas for ice jams. The best means to determine vulnerability is to evaluate patterns and frequency of previous ice jam flooding. Ice jam events recorded the by US Army Corps of Engineers (USACE CRREL,2004) have been plotted to show spatial occurrence (**Figure 3.3.2-4**). Areas that experienced ice jam events in the past are the most likely to experience future flooding related to ice jams.

Dam Failure Flooding
Vulnerability to dam failure flooding is compounded by the fact that the false sense of security created by an upstream dam encourages settlement in the flood hazard area below the dam. Extreme events could exceed the flood storage capacity of even large reservoirs. At such times, the excess water passed over the spillway (the primary purpose of which is to protect the dam) may cause damages downstream which could approach those that would have occurred had the dam not been built. However, the failure of a dam could produce flood rates and damages in excess of that which would have resulted if the dam had not been built. Source: MDES, 1996.

There are approximately 2,852 dams within the State of Montana (USACE NID, 2004). Of these dams, 171 are "high-hazard dams", indicating they are upstream from populated areas (USACE NID, 2004) (**Figure 3.3.2-5**). **Table 3.3.2-6** summarizes the hazard categories of dams by type of ownership.

Table 3.3.2-6 Number of Dams within the State of Montana.
Source: USACE NID, 2004.

Hazard Categories	**Number of Federal Dams**	**Number of State Dams**	**Number of Local Government Dams**	**Number of Public Utility Dams**	**Number of Private Dams**	**Total**
High	51	28	30	6	56	171
Significant	18	2	4	10	163	197
Low	25	116	35	2	2,289	2,467
Undetermined	17	0	0	0	0	17
TOTAL	**111**	**146**	**69**	**18**	**2,508**	**2,852**

Figure 3.2-3 Flood Insurance Policies

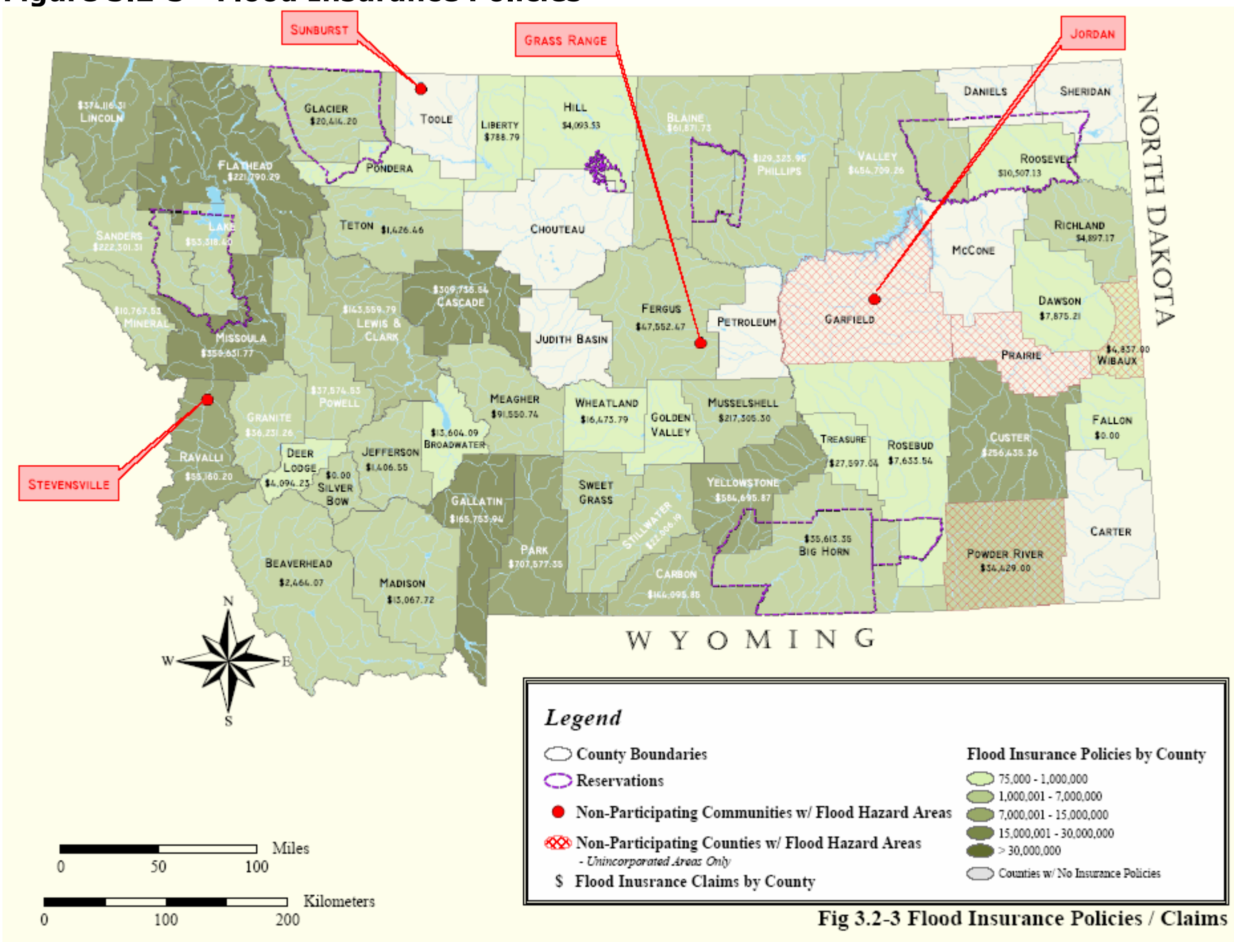

Figure 3.2-4 Ice Jam Locations

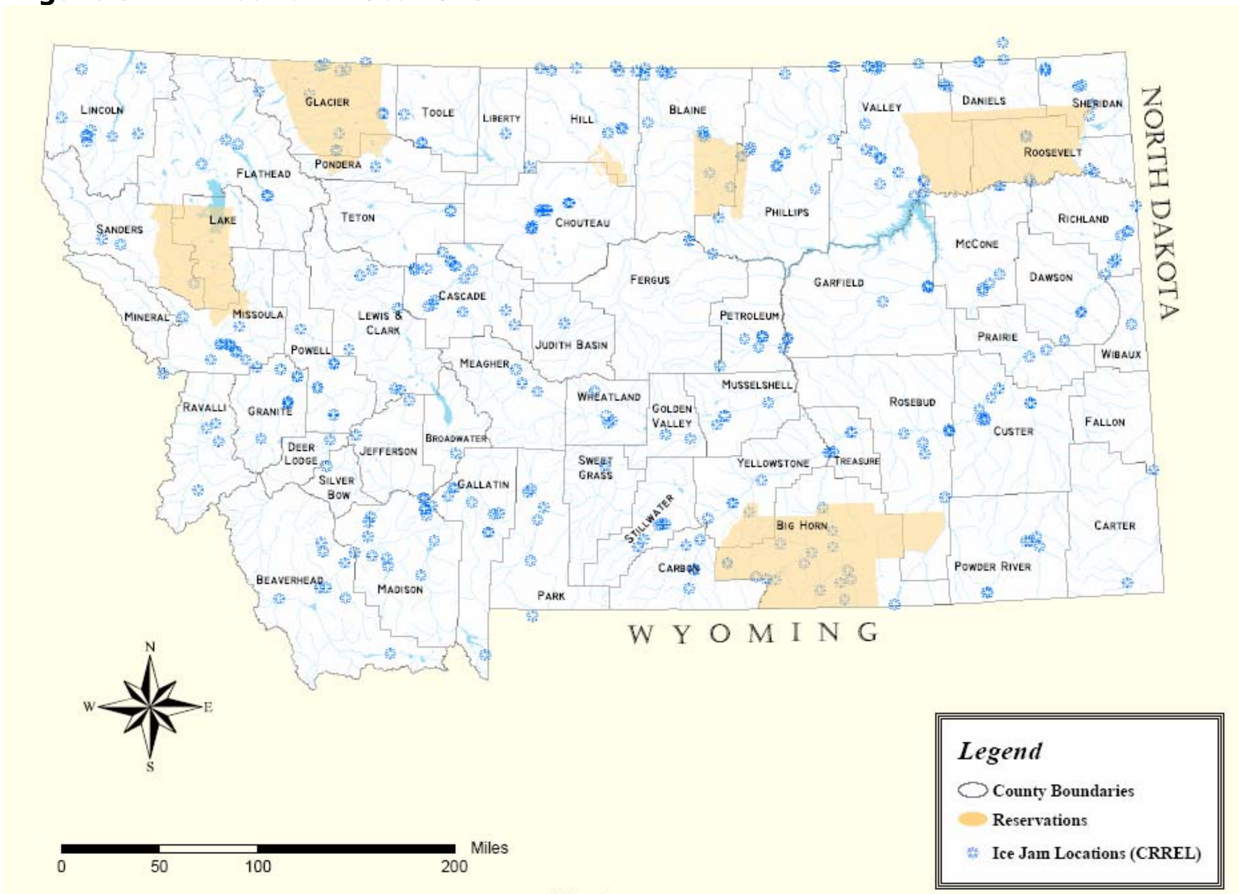

Fig 3.2-4 Ice Jam Locations

Figure 3.2-5 High Hazard Dams

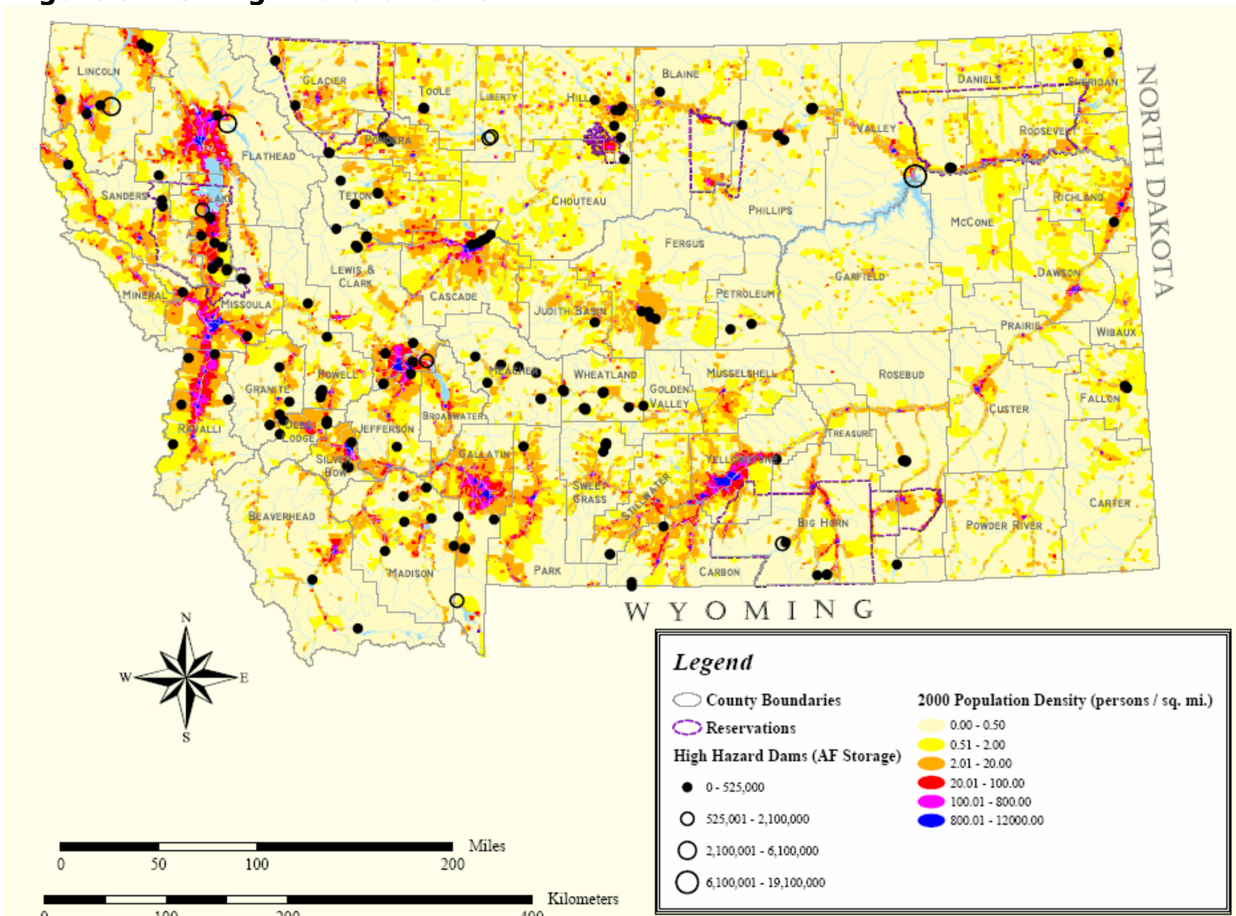

Fig 3.2-5 High Hazard Dams

Dams with Deficiencies or Requiring Further Analysis

In 1981, the United States Army Corps of Engineers (USACE) completed inspection of non-Federal dams in Montana. Generally, the USACE inspected dams that were at least twenty-five (25) feet high or impounded at least fifty (50) acre-feet of water and were located upstream from populated areas or areas where dam failure could cause serious property damage. Deficiencies were found in 32 of the dams inspected by the USACE (MDES, 1996). Since that time, the Montana DNRC has determined that 20 of the 32 dams meet State standards, either because of reduction in storage capacity, rehabilitation, or re-evaluation (Lemieux, 2004). **Table 3.3.2-7** shows the remaining 12 dams on the 1981 USACE list, plus 3 more dams determined deficient by DNRC (numbers 13-15).

Table 3.3.2-7 Non-Federal dams in Montana Requiring Further Analysis or Rehabilitation. Source: MDES, 1998; Lemieux, 2004.

Name	County	River	Nearest Community
1. South Sandstone Creek Dam	Fallon	South Sandstone Creek	Plevna
2. Big Casino Creek Dam*	Fergus	Big Casino Creek	Lewistown
3. East Fork Dam*	Fergus	East Fork Big Spring	Lewistown
4. Hanson Creek Dam*	Fergus	Hanson Creek	Lewistown
5. Pike Creek Dam*	Fergus	Pike Creek	Lewistown
6. Lower Willow Creek Dam*	Granite	Lower Willow Creek	Hall
7. Big Sky Dam*	Madison	Middle Fork, West Fork, Gallatin River	Gallatin Gateway
8. Ruby Dam*	Madison	Ruby River	Alder
9. Willow Creek Dam*	Madison	Willow Creek	Willow Creek
10. Cottonwood Dam*	Park	Cottonwood Creek	Wilsall
11. Yellow Water Dike*	Petroleum	Yellow Water Creek	Mosby
12. Yellow Water Main*	Petroleum	Yellow Water Creek	Mosby
13. Upper Taylor Dam	Powell	Upper Taylor Creek	Deer Lodge
14. Northern Pacific Reservoir Dam	Jefferson	McClellan Creek	East Helena
15. Dry Fork Dam	Blaine	Dry Fork Creek	Chinook

* Compliance with spillway standards has not yet been completed.

3.3.2.4.2 Review of Potential Losses in Local PDM Plans

Each of the 6 counties completing local PDM Plans identified flooding as a hazard, but only two identified flooding as one of the top hazards in terms of vulnerability:

- Daniels County ranked flooding as having the highest risk to buildings, population impacted, and the number of critical facilities potentially affected.
- Yellowstone County stated that there was a very high probability for future flooding, citing the frequency of floods in the county. The county did identify that the risk of flooding from dam failure was low.

3.3.2.4.3 Vulnerability to State-Owned Facilities

The State completed a floodplain determination on the 4,300 buildings owned or leased by the State. The results showed there are 29 buildings located within flood hazard zones (**Table 3.3.2-8)**. The total building exposure is **$11.2 million** (based on insured amount) and **$4.2 million** in content. Assuming a loss ratio of 22% building value and 33% content value, the potential losses could be **$3.9 million**.

Table 3.3.2-8 State Buildings within Flood Hazard Zones. Source: Intermountain Hazards, 2003.

Agency	Identification	City	Building Insured Amt	Content Insured Amt
Fish, Wildlife & Parks	Big Springs Hatchery-Lewistown	Lewistown	$370,000	$64,800
Fish, Wildlife & Parks	Region 7 Headquarters	Miles City	$500,000	$221,400
Fish, Wildlife & Parks	Intake Structure	Miles City	$424,492	$75,600
Fish, Wildlife & Parks	Raceways-Big Springs Hatchery	Lewistown	$298,800	$75,600
Fish, Wildlife & Parks	Maintenance Shop (aka Old Hq)	Miles City	$370,800	$82,400
Justice	Gymnasium	Helena	$484,100	$45,300
Labor & Industry	Miles City Job Service	Miles City	$244,800	$98,100
Military Affairs	Chinook Armory	Chinook	$500,000	$261,700
Military Affairs	Chinook Organizational Maintenance Shop	Chinook	$226,500	$152,700
Natural Resources	Rubber Dams	Toston	$500,000	$103,000
Transportation	Miles City Equipment Storage	Miles City	$500,000	
Transportation	Glendive Six-Stall Equipment Storage	Glendive	$163,800	$110,500
Transportation	Browning Equipment Storage	Browning	$158,600	$106,900
Transportation	Glendive Eight-Stall Equipment Storage	Glendive	$154,300	$104,100
Transportation	Miles City Office/Shop II	Miles City	$500,000	$475,800
Transportation	Miles City Old Shop	Miles City	$329,600	$77,200
Transportation	Glendive Office/Shop	Glendive	$500,000	$500,000
Transportation	Browning Equipment Storage	Browning	$339,600	
Transportation	Rest Area	Bridger	$500,000	
Transportation	Rest Area	Emigrant	$500,000	
Transportation	Rest Area	Dutton	$500,000	
Transportation	Weigh Station	Kalispell	$150,000	$50,000
Montana Tech of UM	College Of Technology	Butte	$500,000	$500,000
Justice	Cafeteria	Helena	$500,000	$360,500
Transportation	Rest Area	Hathaway	$500,000	
Corrections	Leased - Missoula	Missoula	$274,000	
Transportation	Rest Area	Gold Creek	$500,000	
Military Affairs	Libby Armory	Libby	$500,000	$431,700
Transportation	Rest Area	Drummond	$500,000	

3.3.2.5 Data Limitations

Limitations to State Building Data

To effectively determine vulnerability for State property, data identifying locations of State buildings is necessary to determine the exposure and vulnerability. The current PCIIS building database is not geo-referenced and cannot be effectively related to spatial coordinates except in general locations (by city or zip code centroid).

USACE CRREL Ice Jam Data (1998, 2004) Limitations

A substantial amount of the USACE CRREL (1998 and 2004) information on ice jams in Montana (about 80%) has come from USGS Water Supply Paper 1679 published in 1966. Other publications include NWS statements, Corps of Engineers' Datacols, other USGS publications, newspapers, and personal accounts. It is important to note that the high number of recorded ice jam events on the Missouri, Yellowstone, and Milk Rivers compared to other rivers in the state reflects information gathered during field visits to that area in August 1997. There could be other rivers that experienced more ice jams than the Missouri River, but because there are few people living near the river, few if any floods or ice jams are ever reported.

The number of ice jams reported in the database for certain years largely depends on the jam location and the availability of jam records. The number of ice jam events reported form Montana increased from the 1940s to the mid-1960s, most likely because of the USGS Water Supply Paper 1679, published in 1966. Because this publication accounts for such a large portion of the Montana ice jam events in the database, it is no surprise that dates prior to its publication would have few recorded ice jam events.

3.3.2.6 Flood References

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